(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 822 529 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
04.02.1998 Bulletin 1998/06

(51) Int. Cl.[6]: **G08G 1/0968**, G06F 3/033

(21) Application number: **97113122.2**

(22) Date of filing: **30.07.1997**

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV RO SI

(30) Priority: **31.07.1996 JP 201982/96**

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(54) Information display system with touch panel

(57) An information display system has a touch panel for selecting an item from a plurality of displayed items by touching. Coordinate differences between each of the coordinates of the plurality of displayed items and the touch position coordinates are calculated. The item having the least calculated coordinate difference is the selected item. Subsequent touchings within a predetermined time and distance are determined to be attempts to correct previous erroneous selections causing probabilities of selecting the previously selected items to be reduced, such as by changing relative calculated coordinate differences to favor selection of other items. Alternatively, a next candidate button can be touched to select the item with the next least coordinate difference.

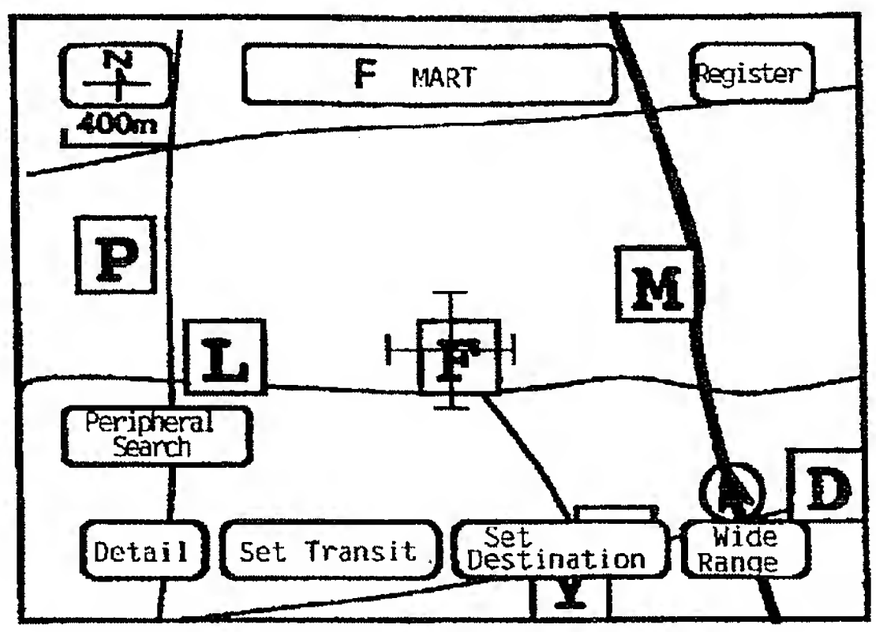

Fig. 7

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Description

The present invention relates to an information display system provided with a touch panel suitable for a navigation system or the like.

In prior art information display systems having touch panels, a variety of information such as menu items are displayed on a display unit, and choices are input by manually touching selected items of the displayed information through the touch panel. When a manual touch is detected, the touch position coordinates on the screen are detected to determine which of the items displayed on the screen has been selected, and processing proceeds in accordance with the item which was selected.

In one vehicular navigation system of the prior art, the display unit is provided with a touch panel to make it easier for an operator to make a variety of settings and to present the information while the vehicle is running. If an item of a particular type such as a convenience store, a gas station or a fast food restaurant is selected on the screen of the navigation system, a landmark of the selected type is displayed on the map in the screen so that the user can easily recognize at a glance the location of the shop of the selected type.

In the aforementioned navigation system of the prior art, a displayed landmark can be selected by touching the desired landmark on the display screen to set a transition point or a destination point for the navigation system. However if the displayed map covers an urbane district or a wide area, a plurality of the landmarks may be densely displayed on the display screen.

The method of selecting a displayed landmark by the touch screen is advantageous in that the landmark can be selected by a single touch. However, the item selected by manual touch may be ambiguous (incapable of being determined) if the landmark to be selected is one of a plurality of closely spaced landmarks.

Thus an erroneous selection can result when densely displayed landmarks are selected through the touch panel, as described above. Even when the user recognizes the erroneous selection and repeats the input, the erroneous selection can be repeated if the dense display state is unchanged. Where items to be selected by touch are displayed densely on the display, erroneous selections occur frequently.

An object of the present invention is to solve the above-specified problems by providing an information display system having a touch panel wherein the system can determine an optimum selected item for the touched position to thus improve the ease of operation. This object is solve with the features of the claim

According to one aspect of the present invention, there is provided an information display system having a touch panel for selecting an item by touch from a plurality of displayed items, wherein the differences between the coordinates of the touched position and the coordinates of the plurality of displayed items displayed on the display screen are calculated, and the selected item is determined to be the one item among the plurality of displayed items having the least calculated coordinate difference from the touched position.

According to a second aspect of the present invention, the plurality of displayed items are marks displayed on the map so that the coordinates of the individual marks are the locations of the marks on the map.

According to third aspect of the present invention, it is further determined whether or not a touch is a selection following an erroneous determination of a selected item, and when it is determined that the present touch is being made to correct a previous erroneous selection, a weighting factor for selection of the previously determined item is lowered.

According to a fourth aspect of the present invention, the determination that a present touch is being made to correct an erroneous selection determined from a previous touch is based on the condition that the present touch is within a predetermined time from the previous touch and that the coordinate difference between the previous and present touch positions are within a predetermined range.

According to a fifth aspect of the present invention, when a determination is made that the present touch is being made to correct an erroneous selected item determined from a previous touch, a value representing the distance between the previously selected item and the present touch position is changed.

According to a sixth aspect of the present invention, wherein the information display system includes a second candidate selecting switch which, when operated, the next item being selected from the displayed items sequentially in the order of increasing coordinate differences.

According to a seventh aspect of the present invention, the items being selected are landmarks or road regulation marks superposed on the map.

According to an eighth aspect of the present invention, selected items including landmarks or road regulation marks can be used as navigation point data.

According to a ninth aspect of the present invention, the selected items are displayed at the center of the screen.

Fig. 1 is a block diagram showing one embodiment of a vehicular navigation system employing an information display system in accordance with the present invention;

Fig. 2 is a diagram of the structure of files of road data used in the system of Fig. 1;

Fig. 3(a) is a diagram of the structure of a file of intersection data used in the system of Fig. 1;

Fig. 3(b) is a diagram of the structure of a file of landmark data used in the system of Fig. 1;

Fig. 3(c) is a diagram of the structure of a file of landmark drawing data used in the system of Fig. 1;

Fig. 4 is a flow chart of the overall operation of the

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navigation system of Fig. 1;

Fig. 5A is a diagram of a display screen showing a present place centralized route guide map;

Fig. 5B is a diagram illustrating touching of a menu item to select a peripheral search.

Fig. 5C is a diagram of a display screen displayed in transiting from the map screen of Fig. 5A to a peripheral search;

Fig. 5D is a diagram illustrating touching of a menu item to select a genre of "Convenience Store".

Fig. 6A is a diagram of a periphery search screen displaying landmarks of the genre "Convenience Store";

Fig. 6B is a diagram similar to Fig. 6A but illustrating selection of a displayed landmark on the screen;

Fig. 7 is a diagram illustrating a peripheral search screen with the selected landmark in the center;

Fig. 8A is a diagram similar to Fig. 6B but illustrating selection of a displayed landmark from densely displayed landmarks;

Fig. 8B is a diagram illustrating a peripheral search screen with a selected landmark in densely displayed landmarks in the center;

Fig. 9A is a diagram similar to Fig. 8B but illustrating an attempt to correct an erroneous selection of a landmark from a plurality of densely displayed landmarks ;

Fig. 9B is a diagram illustrating a peripheral search screen with a corrected selection of a landmark in the center;

Fig. 10 is a graph showing coordinates of a touch position and a plurality of landmarks during determination of a selected landmark from a plurality of densely displayed landmarks;

Fig. 11 is a flow chart of first portion of a procedure performed during a periphery search;

Fig. 12 is a flow chart of a second portion of a procedure performed during a periphery search;

Fig. 13A is a view similar to Fig. 8A but in a modified procedure;

Fig. 13B is a diagram illustrating a peripheral search screen with a selected landmark in densely displayed landmarks in the center in the modified procedure;

Fig. 14A is a diagram showing selection of a item in a further modified landmark selecting screen in which the landmarks are densely displayed;

Fig. 14B is a diagram of a peripheral search screen with a selected landmark in densely displayed landmarks in the center in the further modified landmark selecting screen;

Fig. 15A is a diagram similar to Fig. 8B but employed in still another modified procedure;

Fig. 15B is a diagram illustrating touching of a menu item "Next Candidate" in the another modified procedure to correct an erroneously selected landmark in densely displayed landmarks; and

Fig. 15C is a diagram of a peripheral search screen in the another modified procedure with the corrected selected landmark in the densely displayed landmarks in the center.

One preferred embodiment of the present invention is applied in a vehicular navigation system shown in Fig. 1. The vehicular navigation system includes: an input/output unit 1 for inputting/outputting information on a route guide; a present position detecting unit 2 for detecting information on the present position of a vehicle; an information memory unit 3 having recorded navigation data necessary for calculating the route, display/voice guide data necessary for providing guidance along the route, and application and/or operating system (OS) programs; and a central processing unit 4 for controlling the entire system.

The input/output unit 1 displays navigation and input selection information or items under control of the central processing unit 4, inputs driver selections such as a destination or instructions, outputs guidance information in voice or on the display screen in accordance with the instructions entered by the driver, and outputs processed data to the printer. For performing these functions, the input portion includes a touch switch or screen 11 for inputting the destination in terms of a telephone number or coordinates on a map and for entering instructions such as requesting route guidance. Alternatively, input may be made by an input device such as a remote controller. The output portion includes a display screen 12 for displaying input selection data on the screen and for displaying route guidance information automatically on the screen in response to a request of the driver; a printer 13 for printing data processed by the central processing unit 4 and data stored in the information memory unit 3; and a speaker 16 for outputting audio route guidance.

The input/output unit can also include a voice recognition unit (not shown) for enabling voice input of instructions and destination points; a card or disc reading unit (not shown) for reading data recorded in an IC card or a magnetic card or disc; a data communication unit (not shown) for transferring data between an information center which stores data necessary for navigation to provide the information through communication lines when demanded by the driver; and an information storage device such as an electronic note storing in advance data intrinsic to the driver such as map data and destination data.

The display 12 is a color CRT or a color liquid crystal display, and displays in colors all the screens that are necessary for navigation, such as a line setting screen, a section diagram screen and an intersection diagram screen based upon the map data or guide data processed by the central processing unit 4, and buttons in the corresponding screen for setting the route, for guidance along the route and for switching to another screen. For example, information such as the name of an approaching intersection is popped up and displayed

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in colors at a suitable time in the section diagram screen.

The display 12 is mounted in the instrumental panel of the vehicle in the vicinity of the driver's seat so that the driver can confirm the present position of his vehicle and can acquire information on the route being traveled by observing the section diagram. The display 12 is equipped with the touch screen 11 having switch elements overlying the displayed function buttons so that the input operations may be executed by touching the button. This input signal generating means, composed of the displayed images of buttons and the overlying touch switch elements, forms the input portion of the hardware.

The present position detecting unit 2 detects or receives information on the present position of the vehicle and includes: an absolute azimuth sensor 24 made of a geomagnetic sensor or the like; a relative azimuth sensor 25 having a steering sensor, a gyro and so on; a range sensor 26 for detecting the distance traveled from the RPM of the wheels; a GPS receiver utilizing the satellite navigation system (GPS); a VICS receiver acting as traffic information acquiring means; and/or a data transceiver 23. The VICS receiver 22 receives road traffic information through FM radio channels, electric beacons or light beacons, and the data transceiver 23 is exemplified by a portable telephone or personal computer for exchanging the information necessary for the navigation with a traffic information center (e.g., ATIS) when demanded by the user.

The information memory unit 3 is an external unit, for example a CD-ROM, having stored programs and data necessary for navigation. The stored programs include a program for searching a route, a program for determining input in accordance with the present embodiment, a program for controlling the display output necessary for video route guidance and for controlling audio output necessary for voice guidance, data necessary for performing the searching, input, output and control functions, and display information data necessary for the route guidance and map display. For example, the stored data includes all the data necessary for the navigation system such as files of map data, search data, guide data, map matching data, destination data and registered point data. Alternatively, the CD-ROM contains only the stored data and the programs are stored in the central processing unit 4.

The central processing unit 4 includes: a CPU 40 for executing a variety of processor or arithmetic operations; a flash memory 41 for receiving and storing programs and data read from the CD-ROM of the information memory unit 3; a ROM 42 with stored programs or procedures for reading stored programs such as checking and updating the programs of the flash memory 41; a RAM 43 for temporarily latching the searched route guide information such as the point coordinates of a set destination, a road name code No. or the data being processed; an image memory 44 for receiving and storing graphic data to be used in generating an image displayed on the screen; an image processor 45 for fetching the graphic data from the image memory 44 in accordance with a display output control signal from the CPU 40 and for processing the graphic data to output video signals to the display; a voice processor 46 for synthesizing or forming analog signals of voice sounds such as words, phrases and sentences, warning sounds or other sounds, as read out of the information memory unit 3 under control of a voice output control signal from the CPU, and for outputting the analog signals to the speaker 16; a communication interface 47 for transferring input/output data to and from the central processing unit 4, the input/output unit 1, the present position detecting unit 2 and the memory unit 3; a sensor input interface 48 for fetching sensor signals from the present position detecting unit 2; and a clock 49 for writing the date and time in the internal diagnosis information. In the route guidance system, the driver can select route guidance by screen display and/or voice output.

Alternatively, the aforementioned program for checking and updating programs in the flash memory may be stored in the external memory 3. The programs for determining input according to the present invention and the other programs for executing the navigation may be wholly stored in a CD-ROM or an external memory medium, or these programs may be partially or wholly stored in the ROM 42 in the central processing unit 4.

The data and programs, when stored in the external memory medium, are input as external signals to and processed by the central control unit of the navigation system so that the various navigation functions can be performed.

In the navigation system, as described above, the flash memory 41 has a relatively large capacity for receiving and storing the programs from the CD-ROM of the external memory unit, and the ROM 42 has a small capacity stored with the programs for starting and reading information and/or programs from the CD-ROM. The flash memory 41 is non-volatile for retaining or latching the stored information even when the power is turned OFF. For starting the CD-ROM, the CPU 40 executes the program in the ROM 42 to check the version of the programs stored in the flash memory 41 and to read the version of the CD-ROM programs from the disk managing information from the information memory unit 3. The loading (or updating) operation of the programs is executed when it is determined that the programs on the CD-ROM are an updated version of the programs in the flash memory 41.

Fig. 2 shows an example of the structure of major road data files A, B, C, D and E stored in the CD-ROM 3 shown in Fig. 1. File A presents a guide road data file containing stored data necessary for calculating the guidance route, such as data respresenting the road number, the length, the road attribute data, the address

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and size of the shape data, and the address and size of the guide data of each of n roads. Each road between branch points has separate road numbers for each direction (outward or homeward). The aforementioned shape data includes, as shown in file B, coordinate data of longitude and latitude for the nodes of each road and for m nodes for each road divided by a plurality of nodes into successive road sections.

The aforementioned guide data includes, as shown in file C of Fig. 2, names of intersections (or branch points), caution point data, road name data, the address and size of the road name data, and the address and size of the destination data.

The aforementioned destination data includes, as shown in file D of Fig. 2, the destination road number, the destination name, the address and size of the destination name voice data, the destination direction data and the running guide data. The aforementioned destination name includes a district name. As shown in File E, the destination direction data are data codes indicating invalid (for disusing the destination direction data), unnecessary (for no guidance), straight, right, obliquely right, rightward turning direction, left, obliquely left and leftward turning direction.

Figs. 3(a) and 3(b) shows data structures of the intersection data and the landmark data, as stored in the CD-ROM 3 of Fig. 1. As shown in Fig. 3(a), the intersection data includes, for each of n intersections, the intersection number, the intersection coordinates (longitude and latitude), information of roads connected to the intersection, and the address and size of the landmarks of the facilities near the intersection on the displayed map. As shown in Fig. 3(b), the landmark data includes, for each of m landmarks, the landmark coordinates (longitude and latitude of the facilities indicated by the landmark), the landmark pattern number, the road faced by the facilities indicated by the landmarks, and the landmark name. As shown in Fig. 3(c), landmark drawing data includes landmark drawing data corresponding to the landmark patterns Nos. 0, 1, 2, - - -, and so on.

The navigation process of the entire navigation system is shown in the flow chart of Fig. 4. Initially any updated programs from the information memory unit 3 are read into the flash memory 41 of the central control unit 4 before start of the program for route guidance. The destination is set (at step S1) by entering the target name such as a place or facilities name, a telephone number, an address, a registered point, or a road name. Next, the present position is detected (at step S2) by the present position detecting unit 2 to display a peripheral map around the present position and the name of the present position. The route from the present position to the destination is searched (at step S3). After the route is determined, route guidance (step S4) such as display of map segments with a present position marker thereon is provided until the destination is reached. If a detour setting is input before the destination is reached, a search area including the detour point is set wherein a portion of the route to the destination searched again, and route guidance continues along the modified route until the destination is reached.

Fig. 5A shows a road map display screen around the present position marker in the display unit provided with the touch panel. On the screen, several touch buttons or switches are displayed in addition to an azimuth or direction indicating mark and a distance scale unit. The displayed touch switches include a peripheral search touch switch for initiating a search for the facilities around the present position; a detail touch switch for displaying a detailed map; a whole route touch switch for initiating a new search for a route to the destination; a re-search touch switch for the starting a re-search by searching the periphery; a wide-range touch switch for displaying a wide-range map; and a return switch for returning to an initial screen for route guidance.

If the peripheral search switch is touched as illustrated in Fig. 5B, the screen of Fig. 5C is displayed wherein the lower portion of the screen shows facility selecting switches such as switches for selecting a convenience store, a parking lot or garage, a gas station, a family restaurant, a bank and so on. For example if the switch convenience store is selected by touching as shown in Fig. 5D, the screen of Fig. 6A is displayed to show landmarks of convenience stores at their locations surrounding the present position. In this method of displaying landmarks, landmarks around the present position in a predetermined region larger than the area displayed on the map screen are acquired by searching the data shown in Fig. 3(b). The acquired landmarks are drawn and superposed on the map screen at their approximate coordinate positions on the basis of the landmark drawing data. If a landmark F is then touched as shown in Fig. 6B, the display screen is changed to the screen shown in Fig. 7 wherein the selected facility, an "F mart" as indicated by the landmark F, is displayed in the road map with the landmark F at the center of the screen. When a set transit switch or a set destination switch is then touched, the facility of the landmark F is set as the transit point or a destination point. A cross mark is displayed over the landmark F as a cursor indicating at its center the point setting position. If instead the register switch in Fig. 7 is touched, the facility, as indicated by the landmark F, is registered as a registered point. If the periphery search switch is touched again in any of the screens of Figs. 6A, 6B or 7, the facilities selecting switches, as shown in the lower portion of the screen of Fig. 5, are again displayed. If it is desired to return to the preceding screen, the release switch (not shown) is touched. As an alternative to redrawing the screen map to display the selected landmark F at the center of the screen, the screen map may remain the same with the selected landmark indicated an a position not in the center of the screen. Furthermore the screen of Fig. 7, may display the business hours, the business content and/or the telephone number of the facility indicated by the landmark F.

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Next, selection by touch switches when the landmarks are densely displayed or closely positioned is described with reference to Figs. 8A, 8B, 9A, 9B and 10.

Figs. 8A and 8B show screens after a predetermined item select switch is touched such as one of the facilities select switches of Fig. 5. At the righthand upper portion of screen 8A, there are displayed dense or closely spaced landmarks Y, K, M and P. The driver attempts to select landmark K by touch but as seen in Fig. 8B the landmark Y is erroneously selected. The screen changes with the landmark Y being centered and with the cursor indicating the selection of the landmark Y by being superposed over the landmark Y. If the driver again attempts to select landmark K by touch as shown in Fig. 9A, the probability of selecting the previously selected landmark Y is lowered, and the landmark K is properly selected so that the cursor is displayed over the landmark K. The central processing unit 4 in determining which switch was selected among a plurality of closely spaced switches in one embodiment lowers the probability of selecting the previously selected landmark Y when a subsequent touch is made within a predetermined time to correct an erroneous selection.

In Fig. 10, small black points indicate the reaction or switch contact points of the touch panel forming a grid on the touch panel; hatched circles indicate the landmark coordinate positions Y, K, M and P; and a solid circle indicates a touch reaction point O sensed by the navigation system. The coordinate difference or distance from the detected reaction point O to each of the landmark coordinate positions Y, K, M and P is calculated; these coordinate differences or distances are shown as long-short dashed lines. The landmarks for which coordinate differences are calculated are all within a predetermined square region around the point O. If the landmark Y is the closest landmark to the point O, the landmark Y is selected the first time that the contact of the reaction point O is detected. If a touch is repeated, that is, if contact of a reaction point in the square region around the previously touched point O is detected after release of the previous contact, the distance between the present reaction point and the previously selected point Y is made less likely to be selected by changing the relative calculated coordinate differences such as by multiplying the calculated coordinate difference of the previous selected landmark by a predetermined coefficient greater than one or by adding a predetermined coefficient. As a result, the distance from the reaction point to the target point K is found smallest of the calculated distances so that the landmark K is selected. Where the touch panel reaction points are made fine or close together so as to match the size of the panel region depressed by a finger, as shown, the probability of erroneous selection is low. For coarser touch panel reaction points, however, the probability of erroneous selection is higher that this arrangement is effective especially in the case of more widely space reaction points.

In the procedure for periphery searching as shown in Figs. 11 and 12, operation (touching) of the periphery search key, as illustrated in Fig. 5B, is detected in step S11 of Fig. 11, and the items or types of facilities available for selection are displayed on the screen as in Fig. 5C. When one genre is selected at step S12 from the displayed items, a search is conducted in step S13 for landmarks corresponding to the selected genre with a region of a predetermined size larger than the region displayed on the screen. Then in step S14, the landmarks found within the display region are displayed on a map of the region as shown in Fig. 6A. When a touch is detected in step S15, the touch position (or reaction point) coordinates (X_0, Y_0) are acquired in step S16 and a square region ($X_0 \pm a$ $Y_0 \pm b$) around the touch position coordinates is set in step 17. If the landmark coordinates are stored in the latitude-longitude coordinate system, the touch position coordinates are transformed into the latitude-longitude coordinate system of the map. Then all landmarks in the square region are acquired in step S18. If one or more acquired landmarks located in the square region are found in step S19, the coordinate differences (Xn, Yn) between all the acquired landmark coordinates and the touch position coordinates are calculated in step S20 and the landmark with the minimum coordinate difference is selected in step S21 and is displayed at the center of the screen in step S22 along with display of the name of the selected landmark on the screen at step S23. If in step S19 it is found that no landmark is in the square region, the touch position is displayed at the center of the screen at step S24, and the routine is ended.

In step S25 of Fig. 12 following step S23, it is determined if any other key (one of the displayed function buttons of Figs. 7, 8B) is touched when the selected landmark is displayed together with its name at the center of the screen. If another key is input, the processing for the key operation is executed in step S26, and the routine is ended. In step S27 it is determined of a touch other than a key has been detected. If not, the procedure continues to cycle through steps S25 and S27. When a touch is detected in step S27, the touch position coordinates (X_0', Y_0') are acquired in step S28, and it is determined whether or not a predetermined time has elapsed after the previous touch in step S29. If within the predetermined time, the coordinate difference between the previous touch position coordinates and the present touch position coordinates is calculated in step S30. If this coordinate difference is found within a predetermined range in step S31, the coordinate differences (Xn, Yn) between the acquired individual landmark coordinates and the touch position coordinates is calculated in step S32. Then in step S33 the calculated coordinate difference between the previously selected landmark and the touch position coordinates is multiplied by a predetermined value greater than one. Thus, when the landmark with the minimum coordinate difference is selected at step S34, the previously selected

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landmark is unlikely to be selected again. The newly selected landmark is displayed at the center of the screen at step S35). The name of the selected landmark is also displayed at step S36, and the procedure returns to step S25 to await another key or touch input. If another key input is to set the destination, for example, the facilities of the selected landmark are set to the destination. If it is found at step S29 that the predetermined time has elapsed from the previous touch or if it is found in step S31 that the touch position are not within the predetermined square region surrounding the previous touch region, the routine shifts back to step S17 of Fig. 11 wherein in another square region is set and the landmarks within this new square region are acquired and displayed with the closest landmark in the center.

In the routine of Figs. 11 and 12, the function of steps S29, S30 and S31 is to decide whether or not the new touch is being made to correct a previous erroneous selection in response to a previous touch. Moreover, the function of step S33 is to lower the probability of selecting the previous erroneously selected landmark again in step S34. In step 33, the calculated distance between the new touch position and the previous erroneous selected landmark is changed by multiplying the coordinate difference (distance) by the predetermined value to thus increase this calculated distance and render distances between other landmarks and the touch position to more likely be the minimum difference selected in step S34, i.e., the increased calculated distance is less likely to be selected as the minimum distance. The predetermined multiplication value may be changed to raise or lower the selecting probability.

Figs. 13A and 13B show selection and display of the selected landmark at the center of the screen with detailed information of the selected landmark. If landmark Y of the densely displayed landmarks Y, K, M and P is touched, as shown in Fig. 13A, the landmark Y is displayed at the center of the screen, and the cursor is displayed superposed on the landmark with the name, business hours, telephone number and parking facilities of the selected landmark displayed in the top portion of the screen. If landmarks in the densely packed region of the selected landmark are subsequently touched, the landmarks near the originally selected landmark are sequentially selected when the touching occurs within a predetermined time of the previous touching.

Figs. 14A and 14B illustrate a selection example in which regulation marks are densely displayed in response to selection of the touch button "another" in Fig. 5D so that construction marks and lane regulating marks are partially overlapped. If a lane regulating mark is selected, the lane regulating mark is displayed at the center of the screen, the cursor is displayed superposed over the lane regulating mark, and lane regulating information such as the date and time of the lane regulation and the content of the regulation are displayed in the upper portion of the screen.

In the foregoing embodiment of a navigation system provided with the touch panel on the display screen, a variety of information can be displayed on the map and can be used as items for selection by touching. Thus many modifications in which the various information is displayed on the display unit provided with the touch panel and used as the items to be selectively touched can be made with departing from the invention. These modifications can be suitably applied to a vehicular display unit having a small display screen.

Figs. 15A and 15B illustrate another example of the correction of item selection in the periphery search. In this example, a next candidate key is display on the screen. If a desired target landmark is not selected from densely displayed landmarks, the next candidate switch is touched. Then, a next remaining landmark is selected. Continued touching of the next candidate key selects the remaining landmarks sequentially in the order of from smaller to larger coordinate differences until the desired target landmark is set.

Specifically, the touch reaction point coordinates are acquired (as indicated by the point O in Fig. 10), and the predetermined region is set around the reaction point to acquire the landmarks contained in the predetermined region. If a plurality of landmarks are acquired, the coordinate difference between the coordinates of each of the acquired landmarks and the coordinates of the touch reaction point may be calculated and stored in the form of a table sequentially in the order from smaller to larger coordinate differences. In the foregoing example, the next candidate switch is touched to select the stored landmarks in their sequential stored order. Also if the predetermined region set at the first touch is touched again, the next candidate may be selected with reference to the aforementioned table.

According to the present invention, as described hereinbefore, when items (or marks) are displayed for selection by a touch panel, the distances between the facilities represented by the items for selection and the touch position are determined from the coordinates of the facilities and the coordinates of the touch positions on the map so that the closest item is selected. Thus, even when the items are densely displayed, the most proper item can be selected for the touch position.

Especially, by applying the present invention to the map display system or navigation system in which the landmarks are displayed on the map and are touched to display the information thereon or to set their points, the optimum select item for the touch position can be selected even if the landmarks are dense in an urban district or when a map covering a wide range is displayed.

Moreover, if it is determined that an item was erroneously selected, the probability of selecting the previously selected item is lowered so that the once selected item is likely not to be selected again so that the operability is improved.

Especially by applying the present invention to a map display system or navigation system in which land-

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marks are displayed on the map and are touched to display information thereon or to set their points and wherein the landmarks are displayed so densely such as in an urban district or in a wide range map, the probability of selection again after a previous erroneous selection is reduced to improve the operability.

The entire disclosure of Japanese Patent Application No. 8-201982 filed on July 31, 1996 including specification, drawings, and abstract is incorporated herein by reference in its entirety.

Fig. 1

1: Input/Output Unit;
2: Present Position Detecting Unit;
3: Information Memory Unit
Disk Management Information
Program
Data
4: Central Processing Unit
11: Touch Switch
12: Display
13: Printer
16: Speaker
21: GPS Receiver
22: Beacon Receiver
23: Data Transceiver
24: Absolute Azimuth Sensor
25 Relative Azimuth Sensor
26: Range Sensor
40: CPU
41: Flash Memory
42: ROM
43: RAM
44: Image Memory
45: Image Processor
46: Voice Processor
47: Communication Interface
48: Sensor Input Interface
49: Clock

Fig. 2

(A)

① Guide Road Data
② Number (n) of Roads
③ Road No.
④ Length
⑤ Road Attribute Data
⑥ Address & Size of Shape Data
⑦ Address & Size of Guide Data

(B)

⑧ Shape Data
⑨ Number (m) of Nodes
⑩ Longitude
⑪ Latitude

(C)

⑫ Guide Data
⑬ Destination Name
⑭ Caution Data
⑮ Road Name Data
⑯ Address & Size of Road Name Voice Data
⑰ Address & Size of Destination Data

(D)

⑱ Destination Data
⑲ Number (k) of Destinations
⑳ Destination Road No.
㉑ Destination Name
㉒ Address & Size of Destination Name Voice Data
㉓ Destination Direction Data
㉔ Running Guide Data

(E)

㉕ Destination Direction Data

-1: ㉖ Invalid
0: ㉗ Unnecessary
1: ㉘ Straight
2: ㉙ Rightward
3: ㉚ Obliquely Rightward
4: ㉛ Rightward Turning Direction
5: ㉜ Leftward
6: ㉝ Obliquely Leftward
7: ㉞ Leftward Turning Direction

Fig. 3

(a)

㉟ Intersection Data
㊱ Number (n) of Intersections
㊲ Intersection No.
㊳ Intersection Coordinates
㊴ Information of Connected Roads
㊵ Address & Size of Land Mark

(b)

㊶ Land Mark Data
㊷ Number (m) of Land Marks
㊸ Land Mark Coordinates
㊹ Mark Pattern No.
㊺ Faced Road
㊻ Land Mark Name

(c)

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47 Land Mark Drawing Data
48 ○ ○ Bank Mark Drawing Data
49 ◊◊ Bank Mark Drawing Data
50 □□ Bank Mark Drawing Data
51 △△ GS Mark Drawing Data
52 ▽▽ GS Mark Drawing Data

Fig. 4

S1 Set Destination/Transit
S2 Detect Present Position
S3 Search Route
S4 Guide Route

Fig. 5

(1)

RETURN
PERIPHERAL SEARCH
DETAIL
WHOLE ROUTE
RE-SEARCH
WIDE RANGE
PERIPHERAL SEARCH

(2)

PERIPHERAL SEARCH
RETURN
CONVENIENCE STORE
PARKING
GAS STATION
FAMILY RESTAURANT
BANK
ANOTHER
CONVENIENCE STORE

Fig. 6

REGISTER
PERIPHERAL SEARCH
DETAIL
WIDE RANGE

Fig. 7

F MART
REGISTER
PERIPHERAL SEARCH
DETAIL
SET TRANSIT

SET DESTINATION WIDE RANGE

Fig. 8

(1)

REGISTER
PERIPHERAL SEARCH
DETAIL
WIDE RANGE

(2)

Y STORE
REGISTER
PERIPHERAL SEARCH
DETAIL
SET TRANSIT
SET DESTINATION
WIDE RANGE

Fig. 9

(1)

Y STORE
REGISTER
PERIPHERAL SEARCH
DETAIL
WIDE RANGE

(2)

SQUARE K
REGISTER
PERIPHERAL SEARCH
DETAIL
SET TRANSIT
SET DESTINATION
WIDE RANGE

Fig. 10

53 Touch Panel Reaction Points
54 Land Mark Coordinate Positions
55 Touch Reaction Positions

Fig. 11

11 Input Peripheral Search
12 Select Genre
13 Search Land Mark Corresponding to Selected Genre
14 Display Land Mark on Map
15 Touch Detected ?
16 Acquire Touch Position coordinates (X_0, Y_0)
17 Seat Square Region (XOPMa, YPMb) around Touch Position Coordinates
18 Acquire Land Mark in Square Region
19 Land Mark ?
20 Calculate Coordinate Difference (Xn, Yn) between Acquired Land Mark Coordinates and Touch Position Coordinates
21 Select Land Mark Minimizing Coordinate Differ-

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ence
22 Display Selected Land Mark at Screen Center
23 Display Name of Selected Land Mark
24 Display Touch Position at Screen Center

Fig. 12

25 Another Key Inputted ?
26 Execute Processing Corresponding to Inputted Key
27 Touch Detected ?
28 Acquire Touched Position Coordinates (X_0', Y_0')
29 Predetermined Time Elapsed from Previous Touch
30 Calculate Difference between Previous Touch Position Coordinates and Present Touch Position Coordinates
31 Coordinate Difference within Predetermined Range ?
32 Calculate Difference (Xn, Yn) between Acquired Individual Land Mark Coordinates and Touch Position Coordinates
33 Multiply Difference between Coordinates of Land Marks till Previous One and Touch Position Coordinates by Predetermined Value
34 Select Land Mark Minimizing Coordinate Difference
35 Display Selected Land Mark at Screen Center
36 Display Name of Selected Land Mark

Fig. 13

(1)

REGISTER
PERIPHERAL SEARCH
DETAIL
WIDE RANGE

(2)

Y STORE
BUSINESS HOURS
TEL:
PARKING AREA

PERIPHERAL SEARCH
DETAIL
SET TRANSIT
SET DESTINATION
WIDE RANGE

Fig. 14

(1)

REGISTER
DETAIL
WIDE RANGE

(2)

LANE REGULATION INFORMATION

DAY/HOURS: 7:00 of 6th to 3:00 of 10th
TWO OF THREE LANES REGULATED

DETAIL
WIDE RANGE

Fig. 15

(1)

Y STORE
REGISTER
PERIPHERAL SEARCH
NEXT CANDIDATE
DETAIL
SET TRANSIT
SET DESTINATION
WIDE RANGE
SQUARE K

Claims

1. An information display system having a touch panel for selecting an item by touching the selected item among a plurality of items displayed on a display screen, comprising:

calculation means for calculating coordinate differences between coordinates of each of the plurality of displayed items and coordinates of a touch position; and
select means for selecting the selected item by determining which item of the plurality of displayed items has the least calculated coordinate difference.

2. An information display system having a touch panel according to Claim 1,

wherein the plurality of items displayed on the display screen are marks displayed on a map so that the coordinates of the displayed items are the locations of the marks on the map.

3. An information display system having a touch panel according to Claim 1 or 2, further comprising

means for deciding whether or not a present touch is being made to correct an erroneous selection made from a previous touch, and
means responsive to a decision that the present touch is being made to correct an erro-

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neous selection for reducing a probability of selecting the previously selected item.

4. An information display system having a touch panel according to Claim 3, wherein said deciding means decides the present touch to be a correction of an erroneous selection based on conditions that the present touch is within a predetermined time from the previous touch and that the coordinate difference between the previous and present touch positions are within a predetermined range.

5. An information display system having a touch panel according to Claim 3 or 4, wherein said probability reducing means reduces the probability of selecting the previous selected item by changing the relative calculated coordinate differences of the previously selected item and the other displayed items to favor selection of one of the other displayed items.

6. A system according to any one of claims 1 to 5, further comprising a second candidate selecting switch, wherein when the second candidate selecting switch is operated, a next item is selected from the plurality of displayed items based on the next least coordinate difference.

7. A system according to any one of claims 1 to 6, wherein the plurality of items displayed on the display screen are landmarks or road regulation marks superposed on the map.

8. An information display system having a touch panel according to Claim 7, wherein the points of the selected items including the landmarks or road regulation marks can be located as navigation data.

9. A system according to any one of claims 1 to 8, wherein the select item is displayed at the center of the screen.

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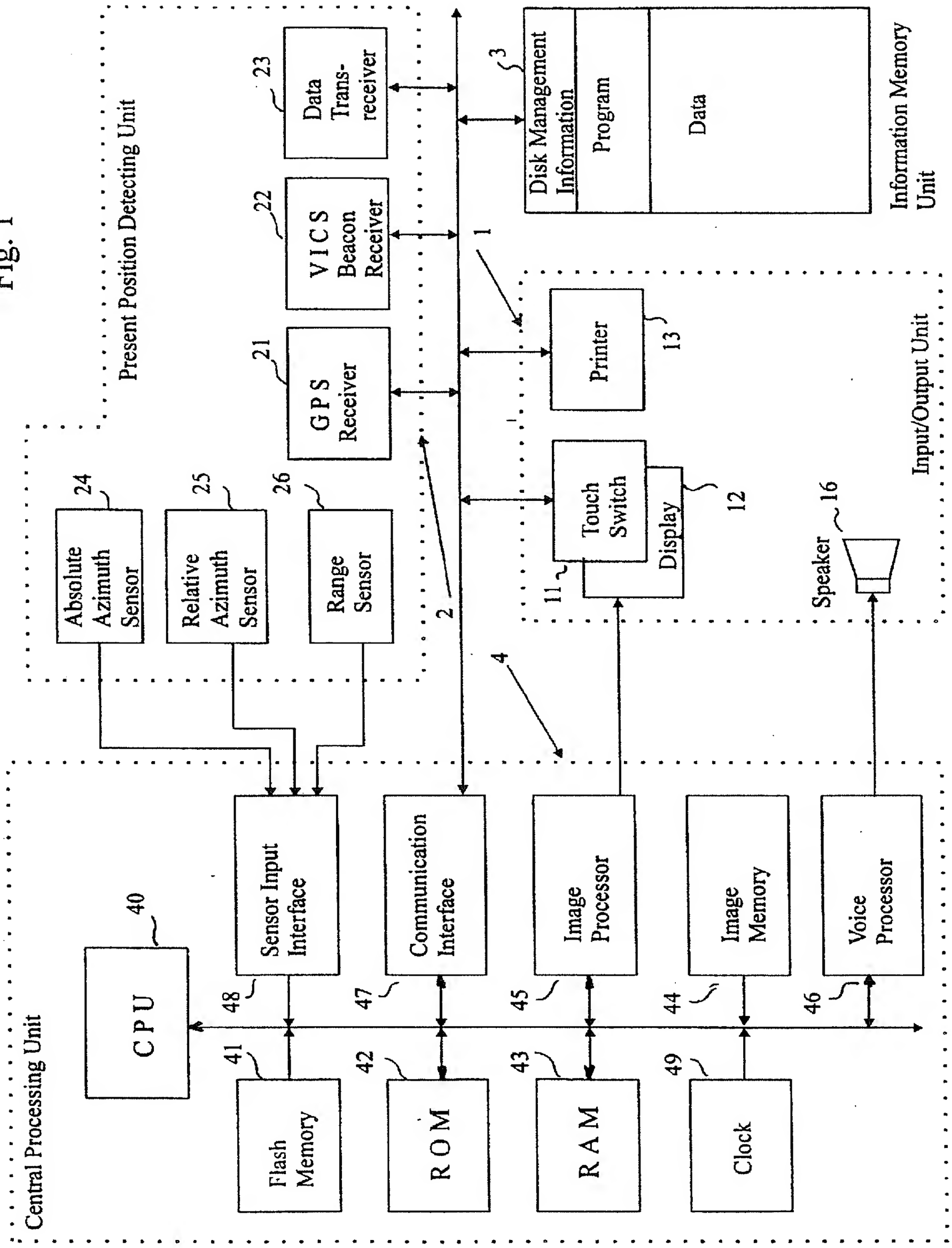
Fig. 1



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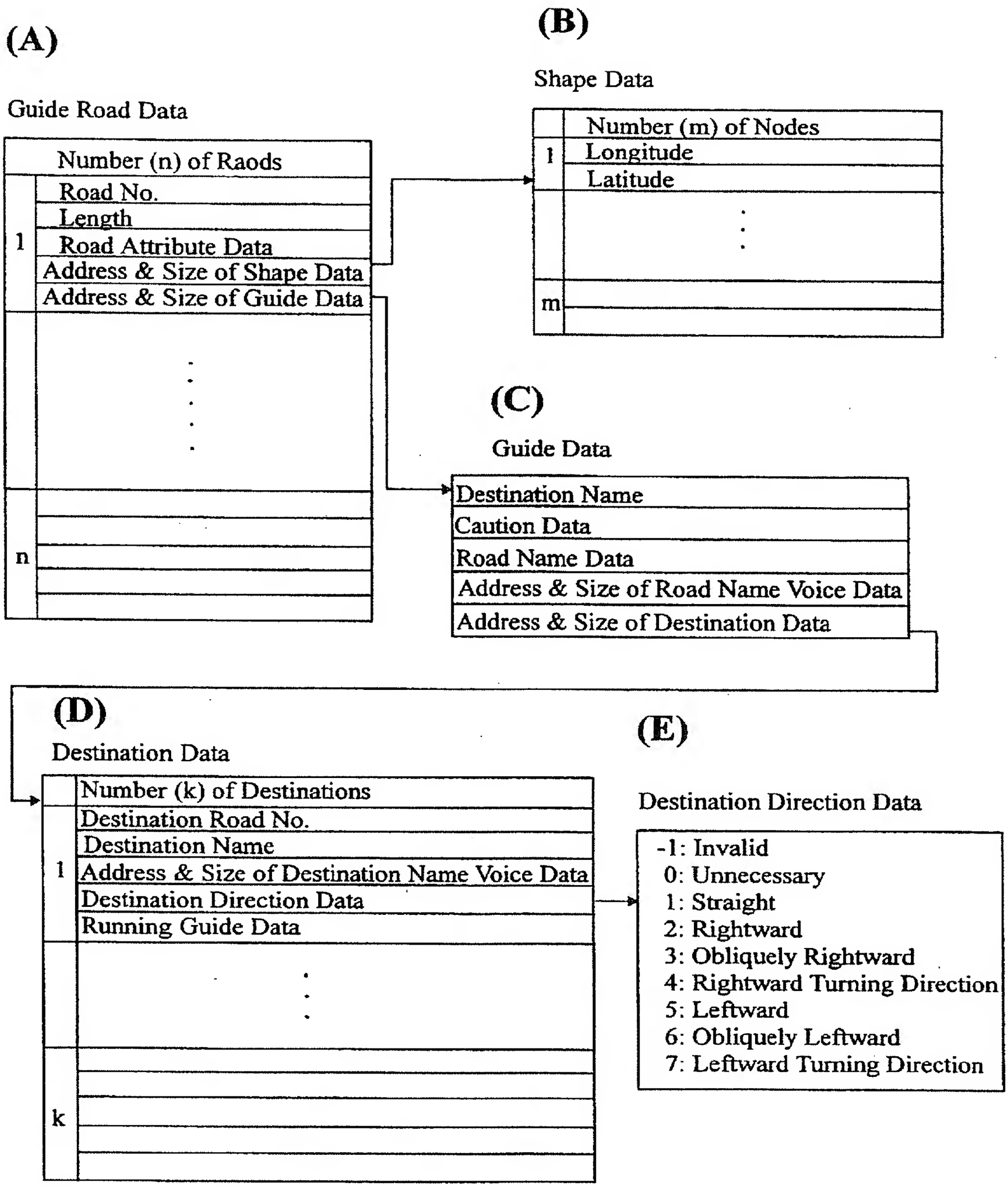


Fig. 2

BNSDOCID: <EP_____0822529A1_I_>

Intersection Data

	Number (n) of Intersections
1	Intersection No.
	Intersection Coordinates
	Info of Connected Roads
	Address & Size of Land Mark
⋮	⋮
n	

(a)

Land Mark Data

	Number (m) of Land Marks
1	Land Mark Coordinates
	Mark Pattern No.
	Faced Road
	Land Mark Name
⋮	⋮
m	

(b)

Land Mark Drawing Data

0 : ○○ Bank Mark Drawing Data
1 : ◇◇ Bank Mark Drawing Data
2 : □□ Bank Mark Drawing Data
3 : △△ G S Mark Drawing Data
4 : ▽▽ G S Mark Drawing Data
⋮

(c)

Fig. 3

BNSDOCID: <EP_____0822529A1_I_>

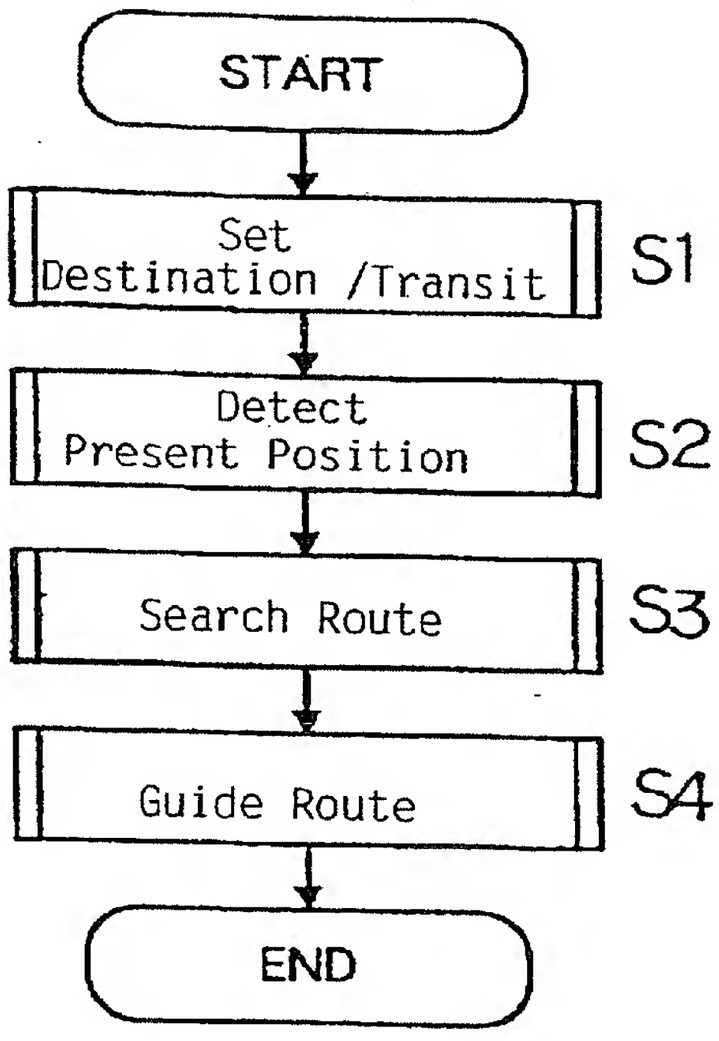
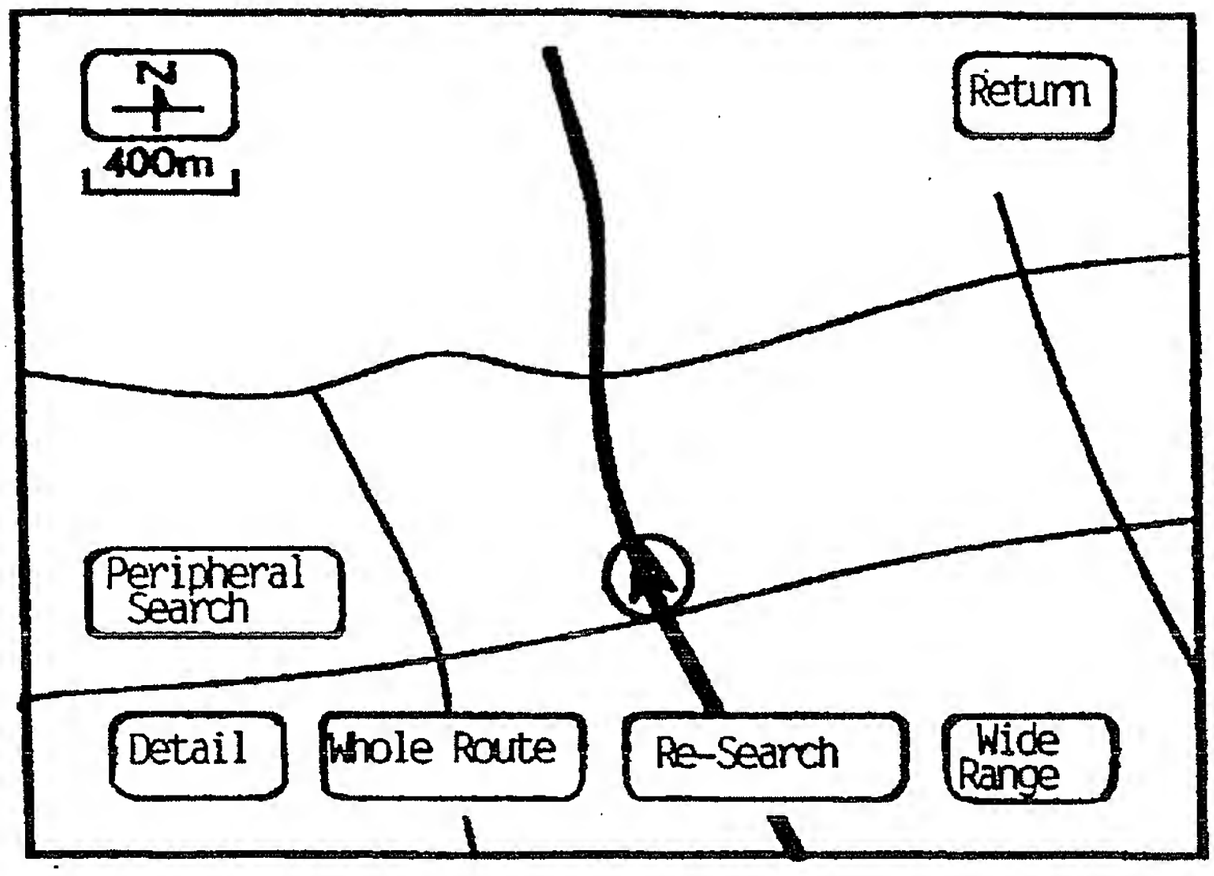


Fig. 4

BNSDOCID: <EP_____0822529A1_I_>

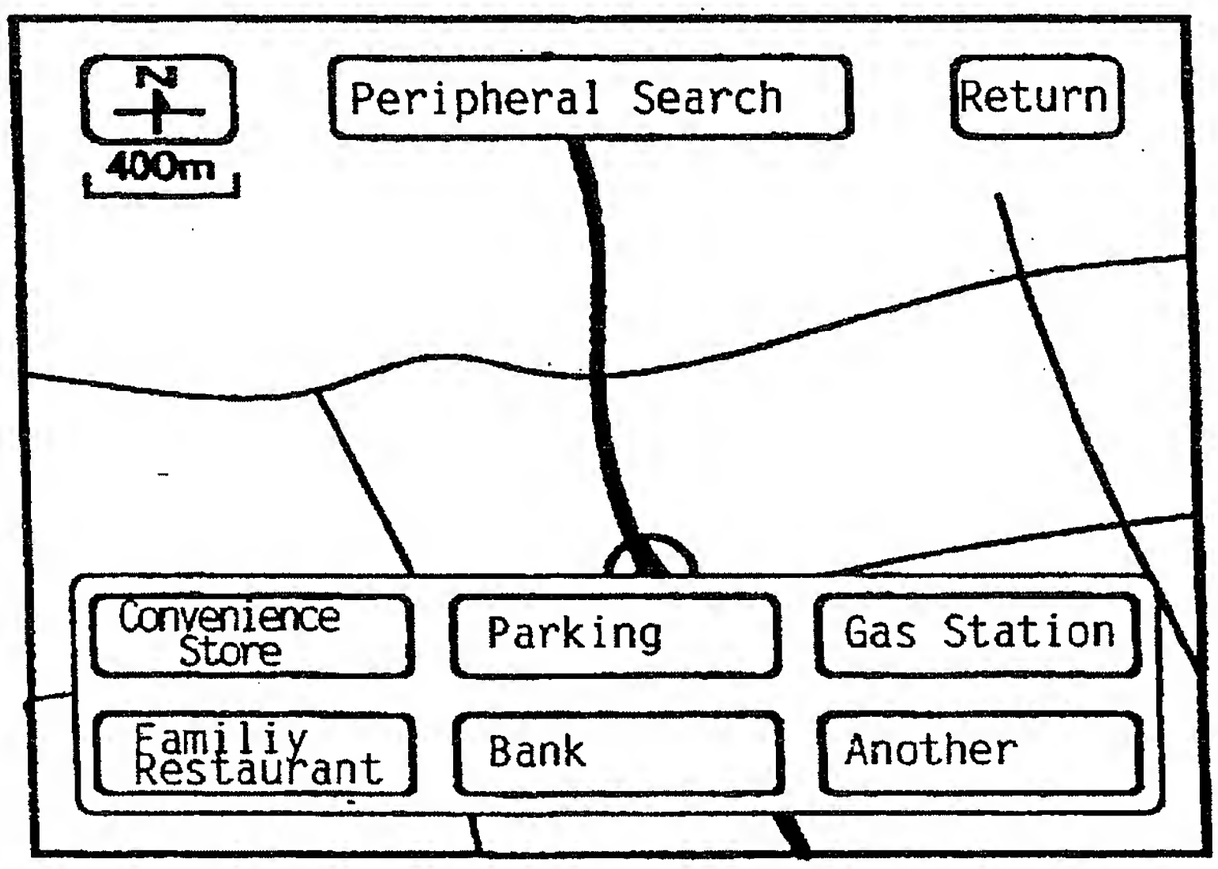
Fig. 5

(A)



(B)

(C)



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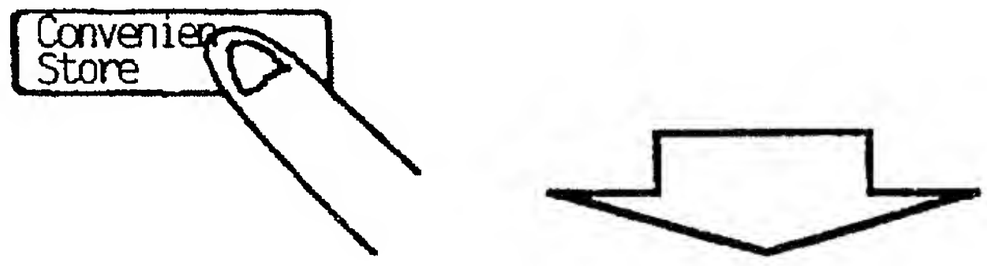

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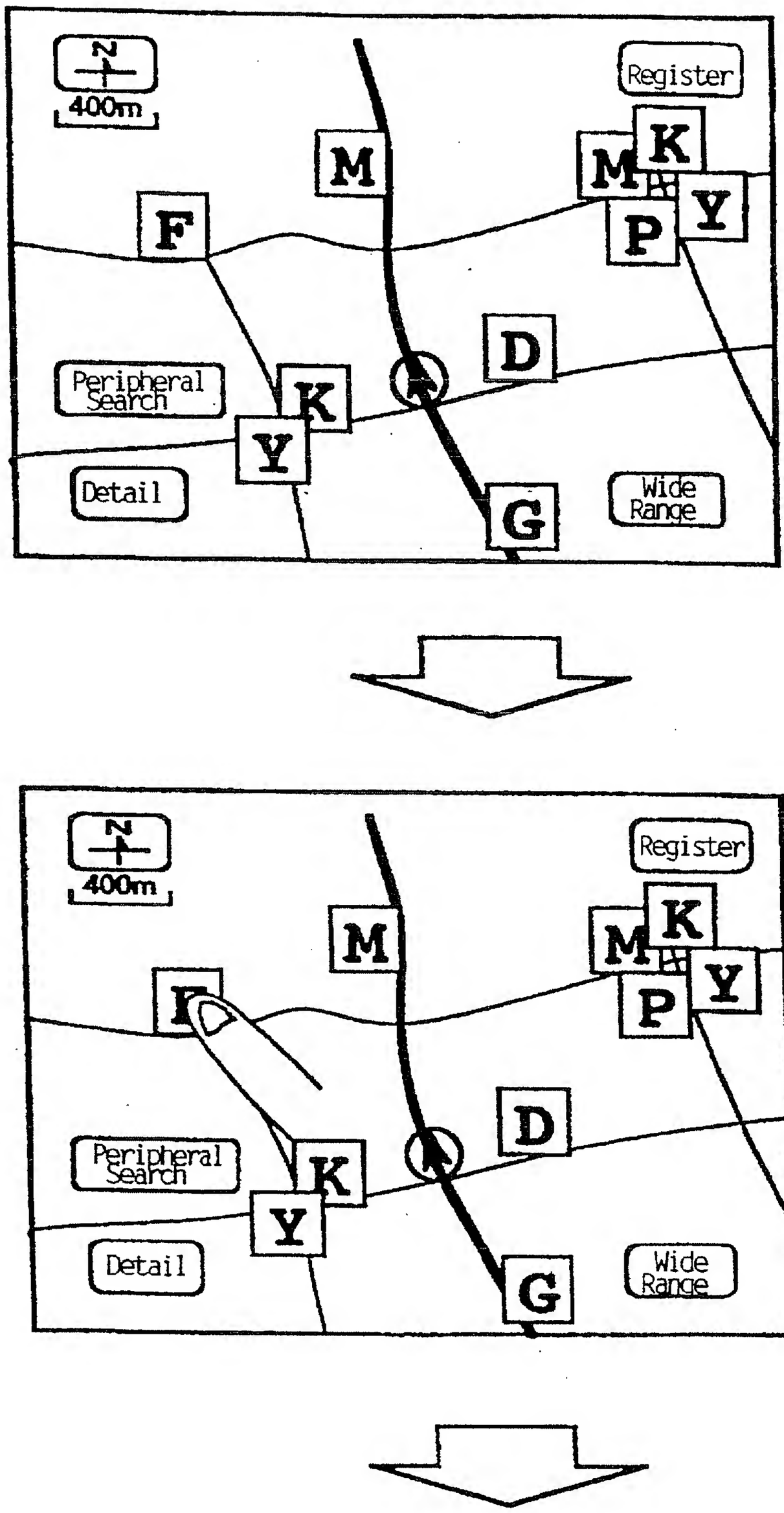
Fig. 6



(A)

(B)

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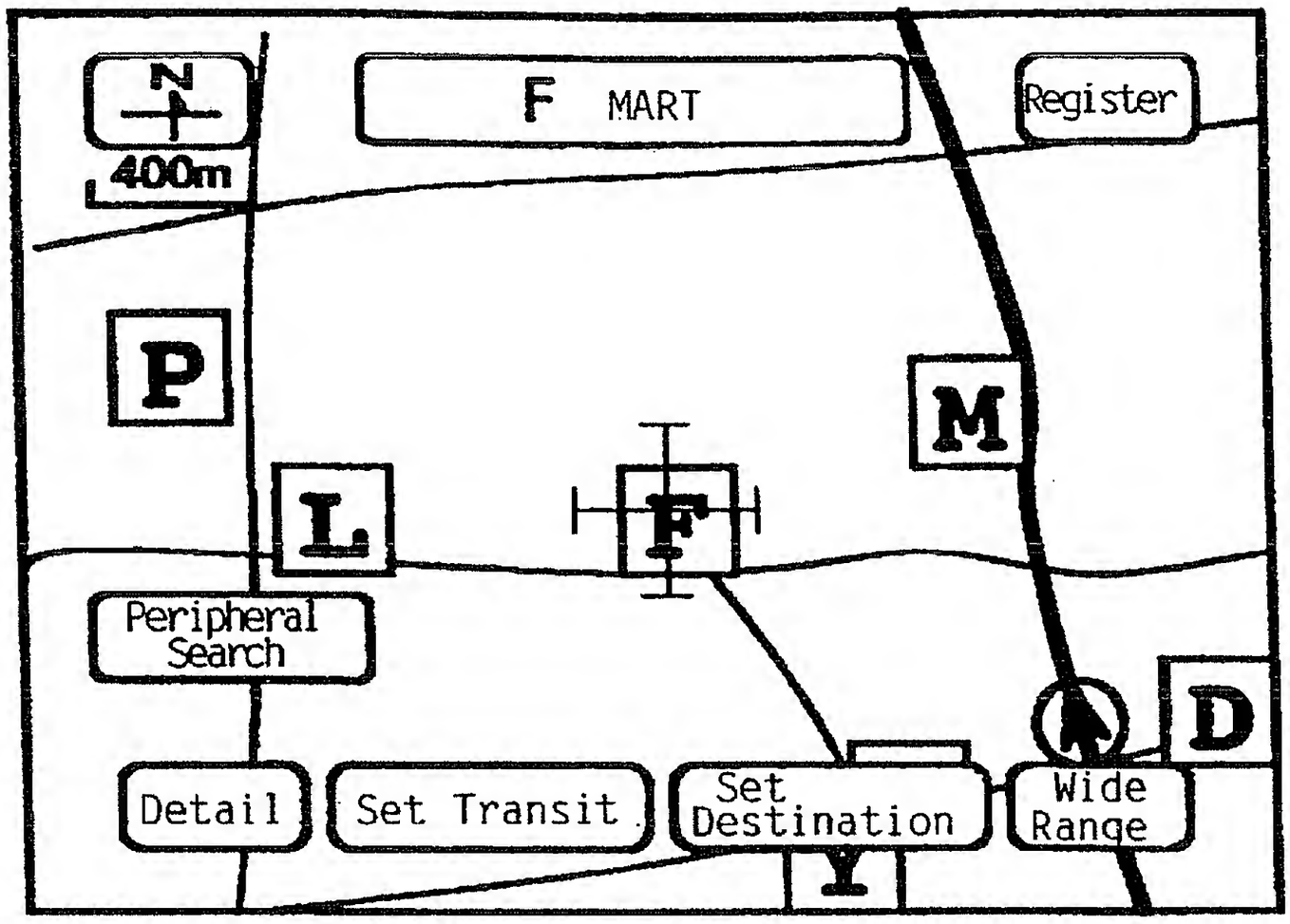

Fig. 7

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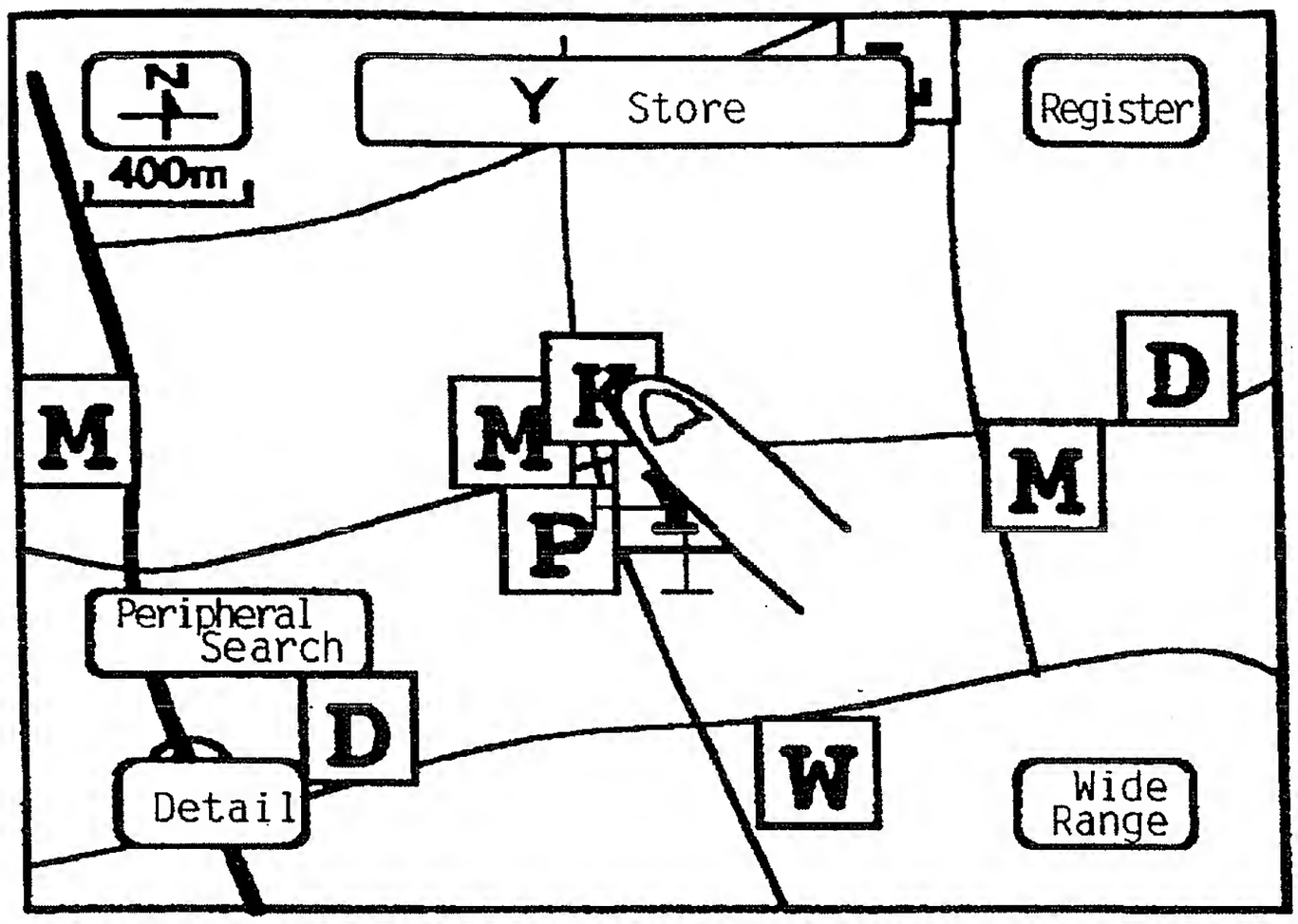
Fig. 8

(A)

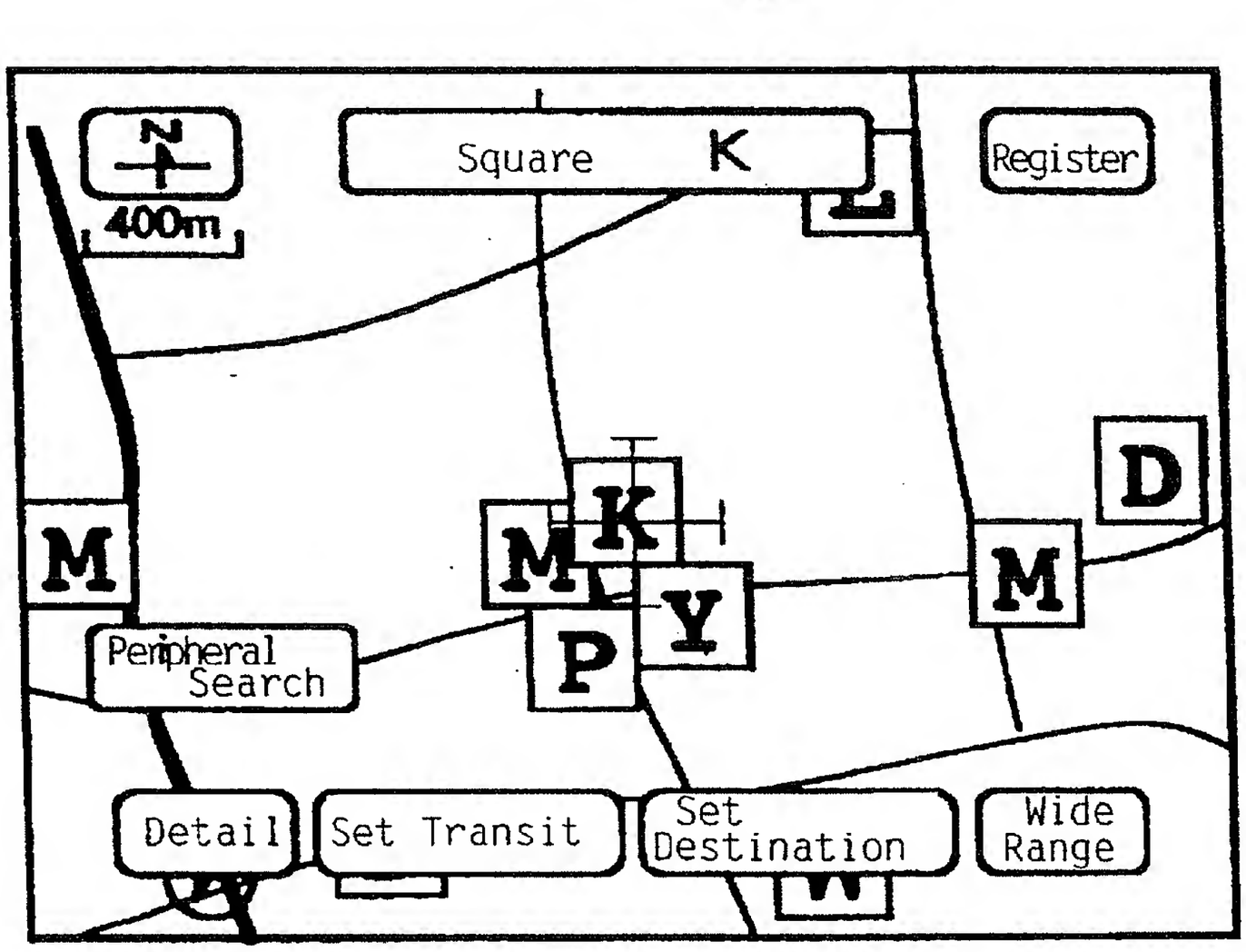
(B)

BNSDOCID: <EP_____0822529A1_I_>

Fig. 9



(A)



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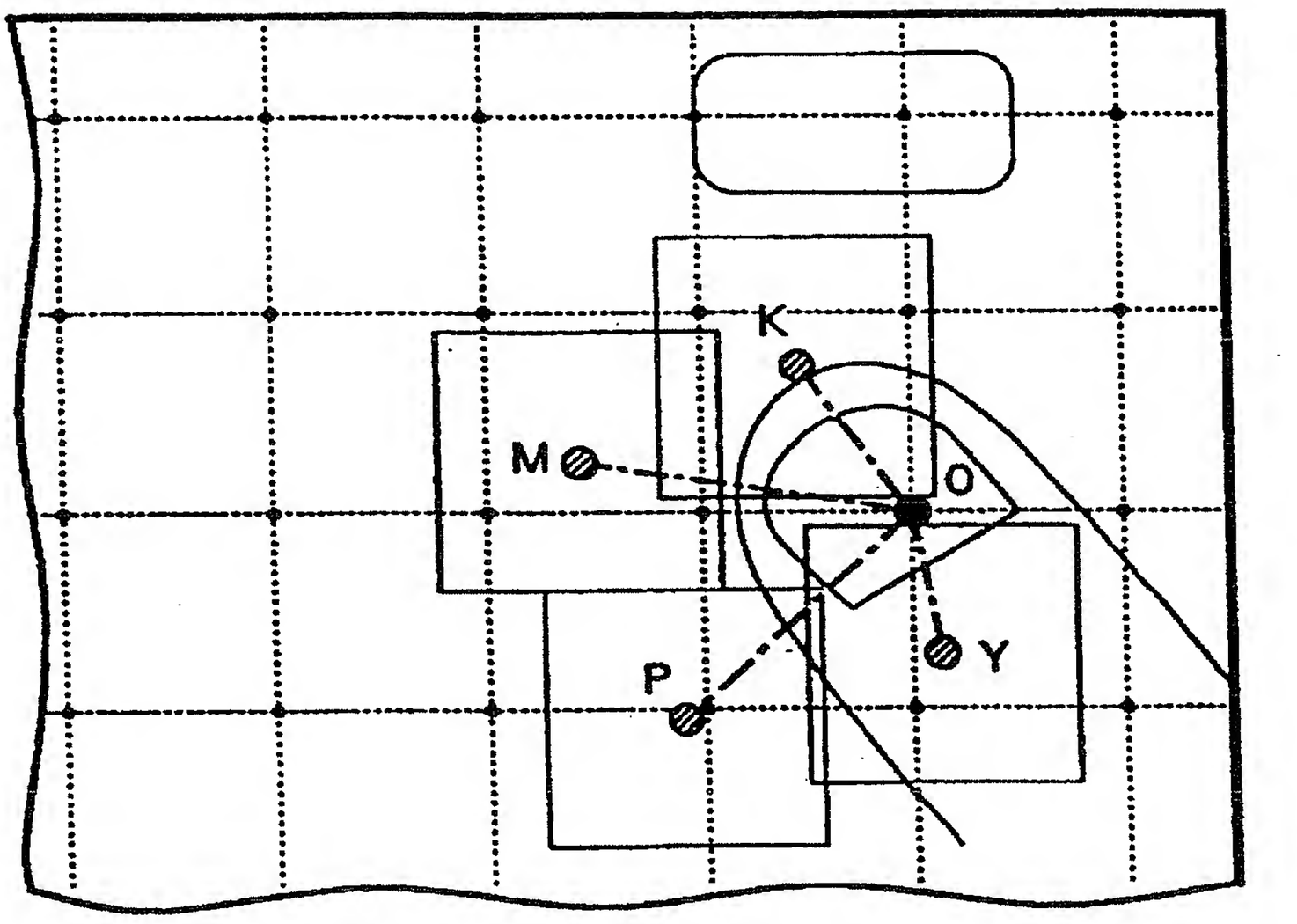

• 53 Touch Panel Reaction Points

◍ 54 Land Mark Coordinate Positions

● 55 Touch Reaction Positions

Fig. 10

BNSDOCID: <EP_____0822529A1_I_>

Fig. 11

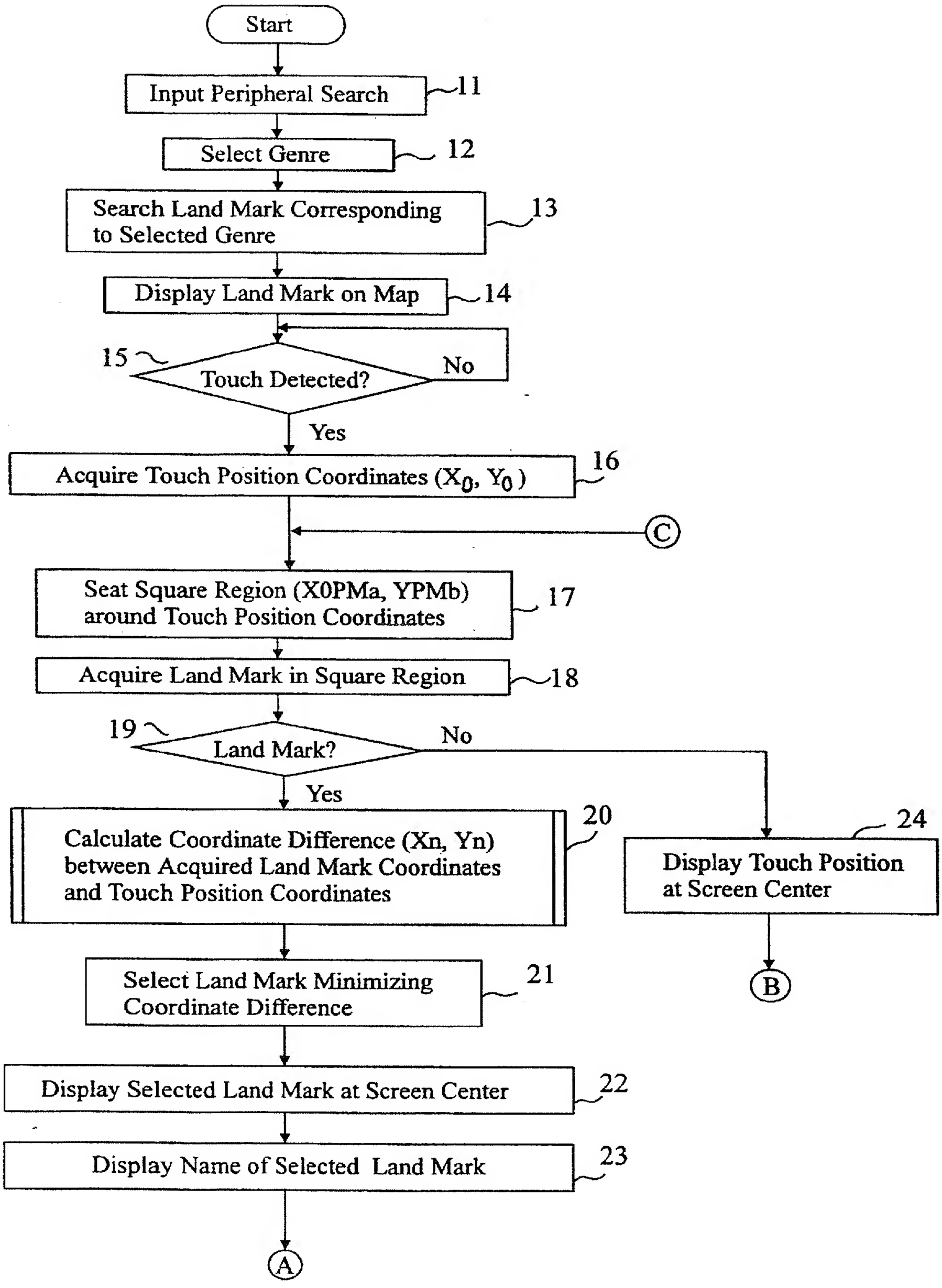

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Fig. 12

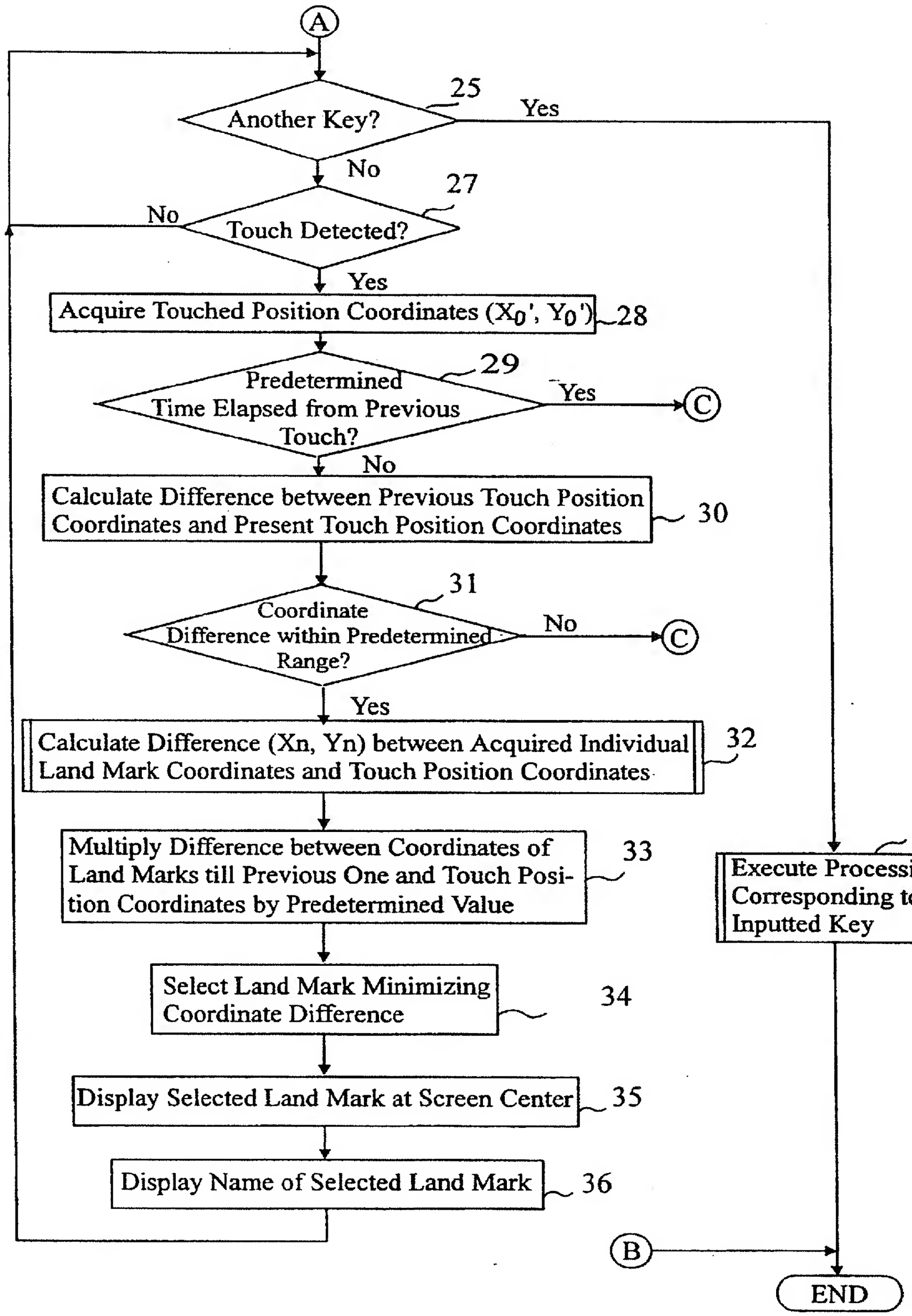

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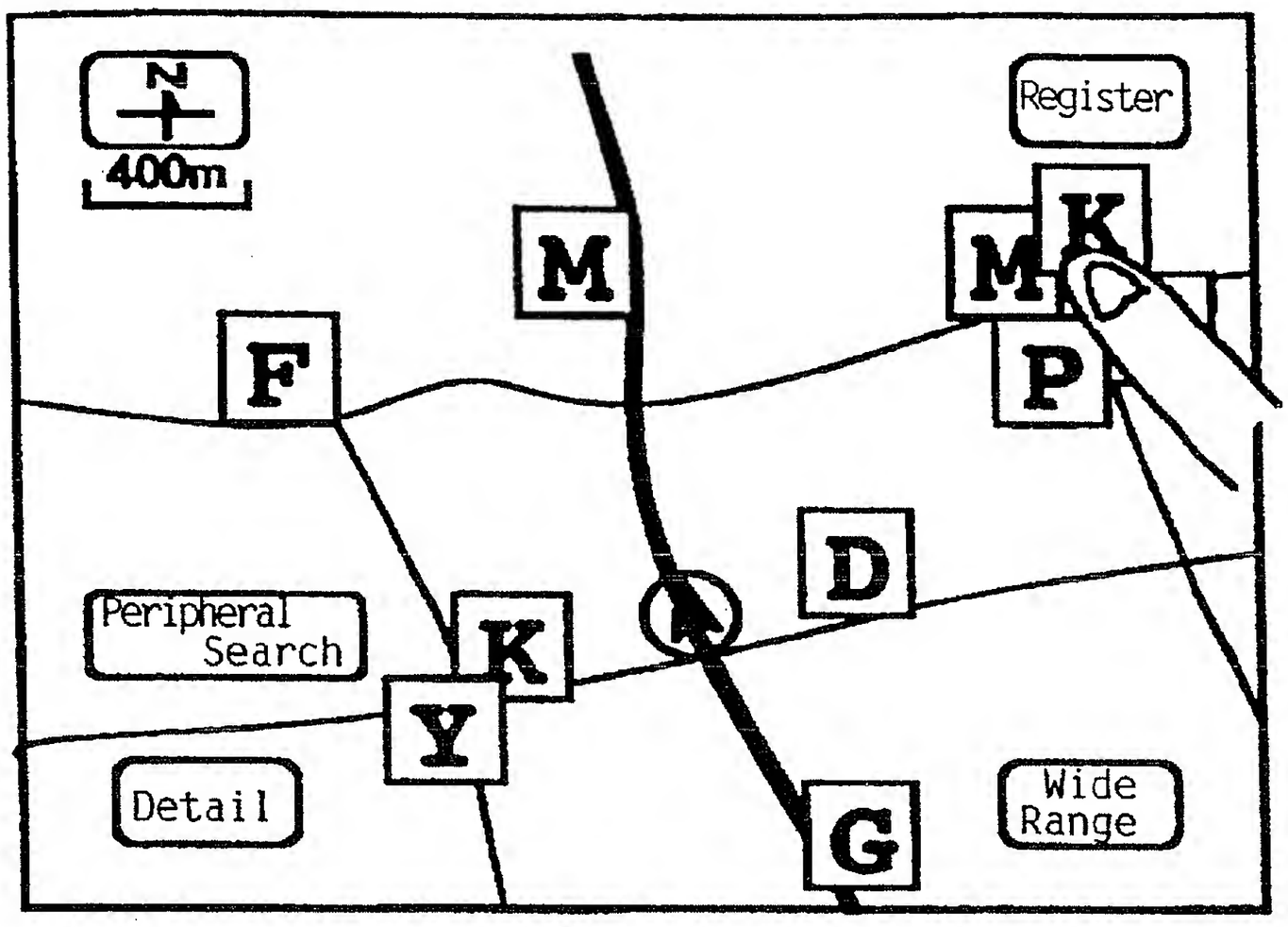
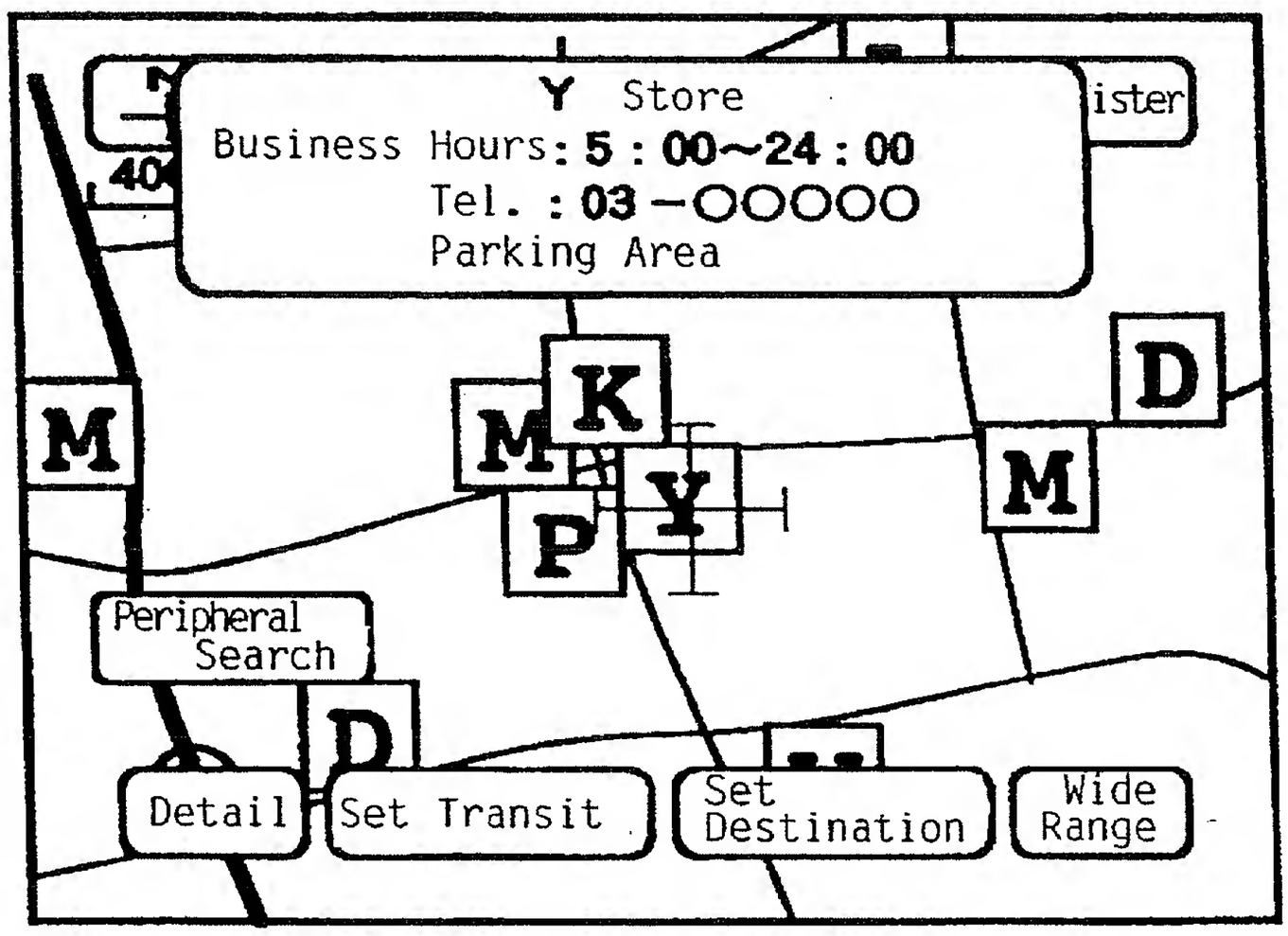
Fig. 13



(A)



(B)

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Fig. 14

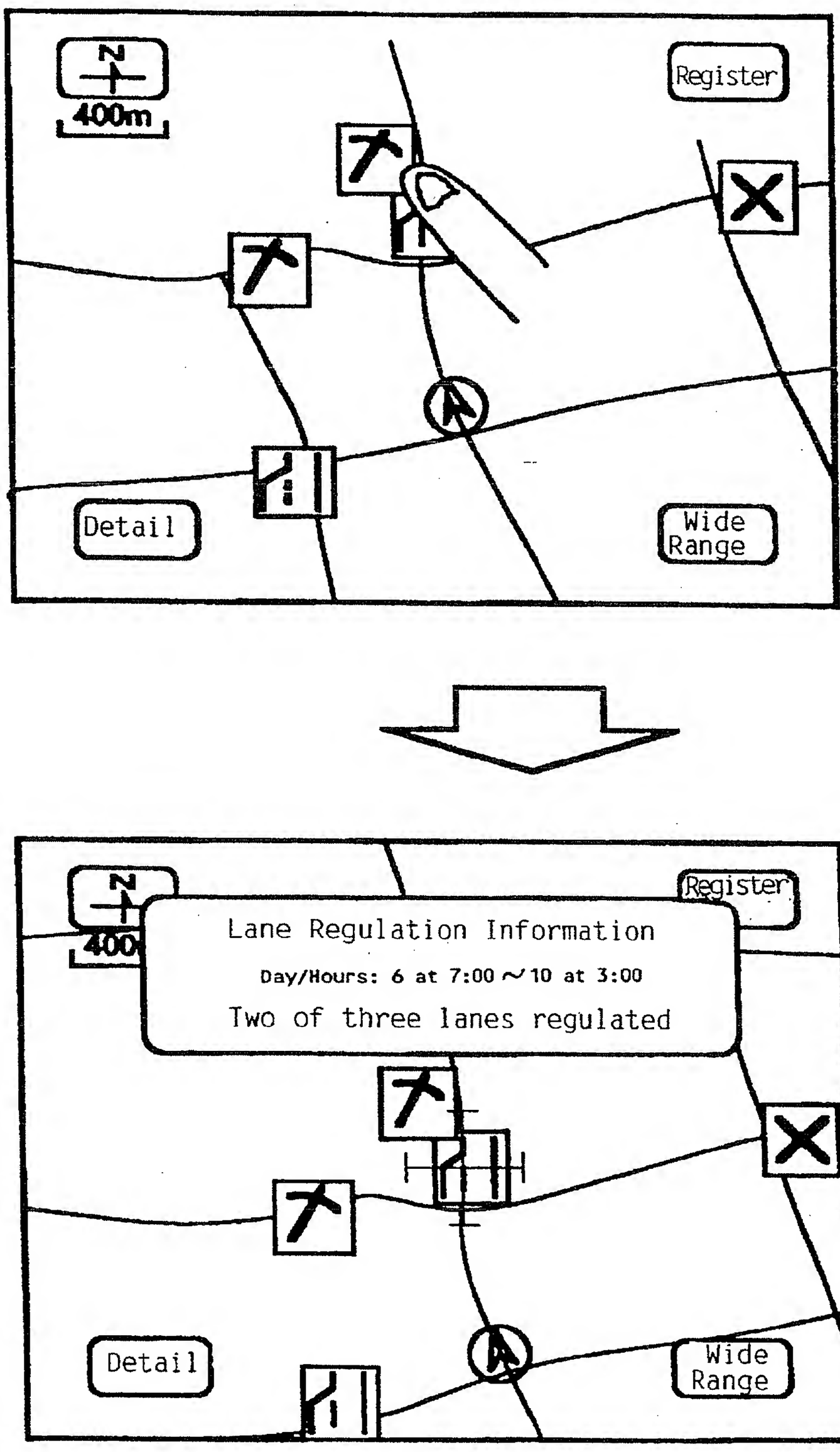

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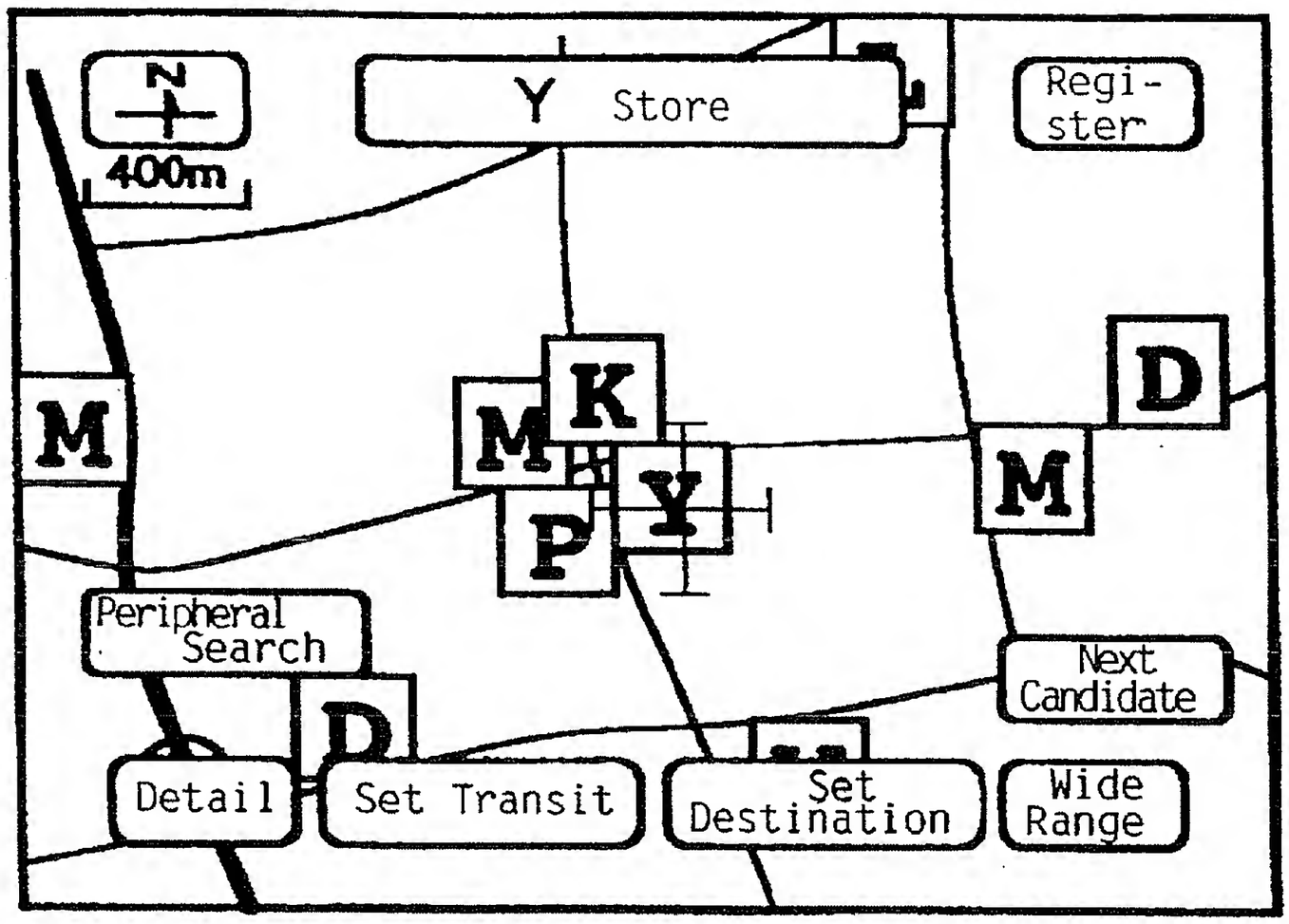
Fig. 15

(A)



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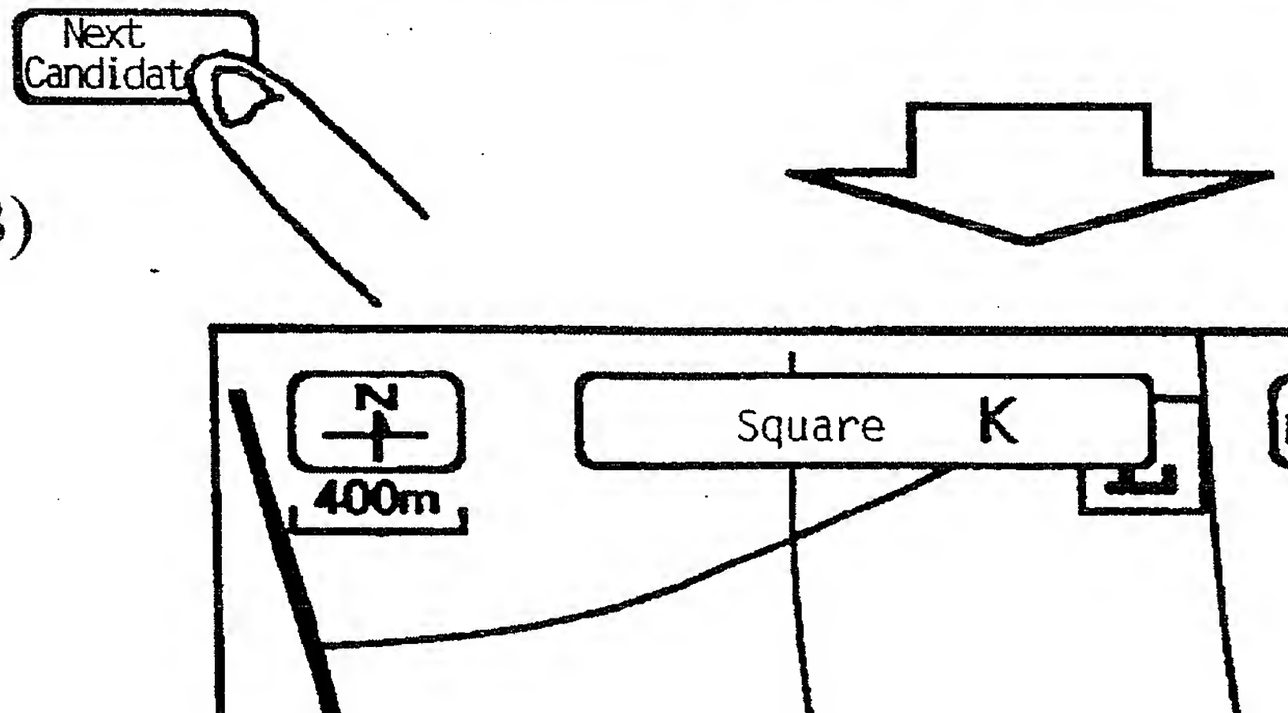
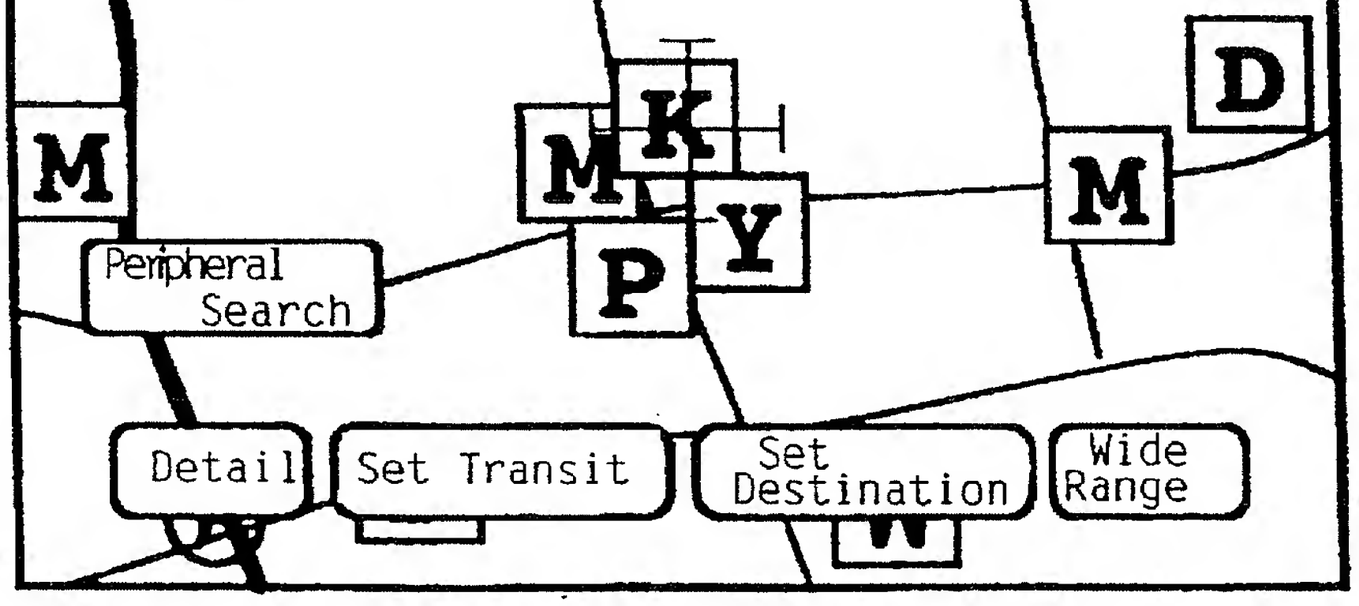


(C)



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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 11 3122

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP 0 703 525 A (AISIN AW CO) * figures 1-33 *	1-9	G08G1/0968 G06F3/033
A	PATENT ABSTRACTS OF JAPAN vol. 096, no. 009, 30 September 1996 & JP 08 123605 A (CASIO COMPUT CO LTD), 17 May 1996, * abstract *	1-9	
A	PATENT ABSTRACTS OF JAPAN vol. 096, no. 009, 30 September 1996 & JP 08 123618 A (HITACHI LTD;HITACHI VIDEO IND INF SYST INC), 17 May 1996, * abstract *	1-9	
A	PATENT ABSTRACTS OF JAPAN vol. 096, no. 003, 29 March 1996 & JP 07 311655 A (CASIO COMPUT CO LTD), 28 November 1995, * abstract *	1-9	
A	PATENT ABSTRACTS OF JAPAN vol. 096, no. 007, 31 July 1996 & JP 08 061964 A (ZANAVY INFORMATICS:KK), 8 March 1996, * abstract *	1-9	
A	US 4 707 845 A (KREIN PHILIP T ET AL)		
P,X	PATENT ABSTRACTS OF JAPAN vol. 097, no. 003, 31 March 1997 & JP 08 292839 A (RICOH CO LTD), 5 November 1996, * abstract *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

G08G
G06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29 October 1997	Crechet, P

CATEGORY OF CITED DOCUMENTS

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L : document cited for other reasons

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